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ABSTRACT

A very diverse population of students choose nursing as a profession in Israel. Although chemistry is basic for studying nursing, most of these students have not studied chemistry in school for longer than a single year--usually in grade 10. A chemistry curriculum for nursing schools was developed, implemented, and evaluated. This curriculum was designed to meet goals identified in a preliminary needs assessment including: (1) the need for a chemistry base for advanced nursing courses, such as biochemistry and pharmacology; (2) the need for content to be applied to students with different backgrounds in science; and (3) the need to increase the usual lack of interest of nursing students in studying chemistry. During the academic year of 1985, the "Chemistry for Nursing Schools" course was studied by 400 student nurses, in 10 nursing schools. The implementation of this course included discussions with teachers employing the new curriculum, the development of teaching aids, and an evaluation using pre- and post-achievement and attitude tests. Both teachers and student nurses indicated that the new curriculum fulfilled a need for a chemistry course for nursing schools, contributed significantly to the improvement of the image of chemistry, and diminished the anxiety often caused by the study of chemistry. (CW)

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The Development and Evaluation of a Chemistry Curriculum for Nursing Schools in Israel

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A varied population of students choose nursing as a profession in Israel. About half of this population consists of young people aged 20-25 (mostly girls), who have previously completed high school followed by two years of military service. The other half consists of young married women and mothers, aged 25 or more, who had finished high school a few years earlier and now wish to learn a profession - nursing. About three quarters of the student population in nursing schools have studied little chemistry in high school. Nevertheless, some knowledge of chemistry is basic to the study of nursing, and chemistry is part of the curriculum during the first year of all nursing schools, though there are differences in content, orientation, and number of weekly hours between one school and another.

The curriculum of a chemistry course for nursing schools must meet three basic requirements, which were identified in a preliminary needs assessment.

1. The curriculum must lay the foundation for other, more advanced nursing courses, such as physiology, pharmacology, etc., and for a number of nursing activities in hospitals and clinics.
2. The curriculum must take into consideration the weak background in mathematics and in science in general of most student nurses.
3. The curriculum must raise the low motivation of nursing students to learn chemistry by indicating its relevance to the profession.

Background

During the past three decades, increasing interest has been shown in the United States and elsewhere in the teaching of chemistry in the context of allied health sciences, as reported by Schomer [1]. As a result of this interest, syllabi and chemistry courses for allied health professionals in general, including nursing, have been developed. Although these courses differ in length and mode of presentation, most of those reported in the literature try to present basic concepts in chemistry in a manner that is relevant to problems of health or disease. Courses for nursing students, which combine inorganic and organic chemistry, as well as some aspects of biochemistry, are reported by Gratz [2], Stanitski and Sears [3], Jones [4], and Frechette and Farina [5]. One interesting course proposed by Jones [4], is entirely based on a patient's clinical laboratory chart.

Genyea and Callewaert [6] have emphasized that while chemistry courses should be interesting and intellectually challenging, they should not be an excessive burden, and certainly not demanding, since most nursing students do not have a strong background in science and mathematics. Reporting on the Task Force on Chemical Education for Health Professions, whose main goal was to design a syllabus for a one- or two-semester

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course in chemistry for health professions, Treblow et al. [7] list the following goals: (a) the laying down of chemical foundations for microbiology, physiology, nutrition, and pharmacology. (b) limiting the topics to be covered to a one-term course. (c) aovoiding the traditional compartmentalization of inorganic, organic and biological chemistry by emphasizing the integration of basic concepts, and (d) reducing the anxiety of students toward studying chemistry.

In order to solve the specific problems of nursing and allied health professions, several chemistry textbooks have been published during the past decade, such as Baum and Scaife [8], Montgomery et al. [9], Sackeim and Lehman [10], Summerlin [11], and Holum [12]. These are excellent books, but Scherz et al. [13] have found that students in Israel have a psychological barrier against using such textbooks in their science courses, since they are written in English, a second language for most students, in which they lack fluency. This probably applies to all students in non-English speaking countries.

Development of the Chemistry for Nursing Schools Curriculum

A chemistry curriculum for nursing schools in Israel has been developed, based on a 'focussed' approach to the subject. The topics in the course were selected very carefully, taking into consideration limits of time (up to 50 lessons), while providing an interesting, challenging course. The weak mathematics and general scientific background of the student population was taken into consideration, but a degree of self study ability and the development of the ability to think at an academic level was required.

The examples in the curriculum from a nurse's everyday work included case studies such as revival of a patient hurt in a traffic accident, and the diagnosis of metabolic acidosis by testing the pH of the blood. Wherever possible, emphasis was put on the quantitative aspects of chemistry and on integrating general chemistry with organic and biochemistry. Each chapter ended with a glossary and questions for revision and self study.

A chemistry curriculum, **"Chemistry for Nursing Schools"**, was developed in the form of a book containing the following eight chapters:

(1) Why Nurses Should Study Chemistry
(2) Molecules in the Human Body
(3) Ions in the Human Body
(4) Introduction to Quantitative Chemistry; Clinical Laboratory Tests
(5) Acids and Bases
(6) Acid-Base Equilibrium in the Human Kidney
(7) Functional Groups in Organic Chemistry
(8) Summary

Implementation of the Curriculum

During 1985 the "Chemistry for Nursing Schools" course was studied by 400 students, in ten nursing schools in Israel. The implementation included discussions with teachers who taught the new curriculum and development of teaching aids (transparencies and solutions for problems provided in the book).

The curriculum, which is made up of 25-50 lessons, was used in two types of nursing schools, those that prepare their students for a B.A. degree in nursing - "academic schools", and those that prepare their students to be registered nurses - "non-academic schools".

The differences between teachers' attitudes and personalities, as well as the orientation of the schools' directors, yielded two types of teaching modes: teaching mode 1 - teachers who implemented the program intensively, and teaching mode 2 - teachers who used the book only as auxiliary material.

Teaching mode 1 was adopted by half of the schools. These schools taught the whole curriculum, using the questions and exercises of the book, the various teaching aids supplied during the course, and set examinations. The two teaching modes of the course were evaluated using pre- and post-achievement and attitude tests.

Evaluation of the Curriculum

The pre-test scores of the achievement tests of the two types of students, academic and non-academic, were compared. The result of the t-test indicated a significant difference between academic and non-academic students for the entire population. Another t-test was carried out for those students who studied according to the intensive teaching mode.

Type of Students	N	Mean Score	S.D.	t	Significance
Academic Students	96	43.4	20.1	3.61	$p < 0.0004$
Non-Academic Students	69	32.8	17.8		

Table 1. t-test for the pre-test scores of teaching mode 1 students

The results in Table 1 confirm the assumption that these two types of students have different backgrounds. However, at the end of the course no significant difference was found between the adjusted means of the two types of students. This effect is clearly

seen in the graph of linear regression lines, which appears in figure 1.

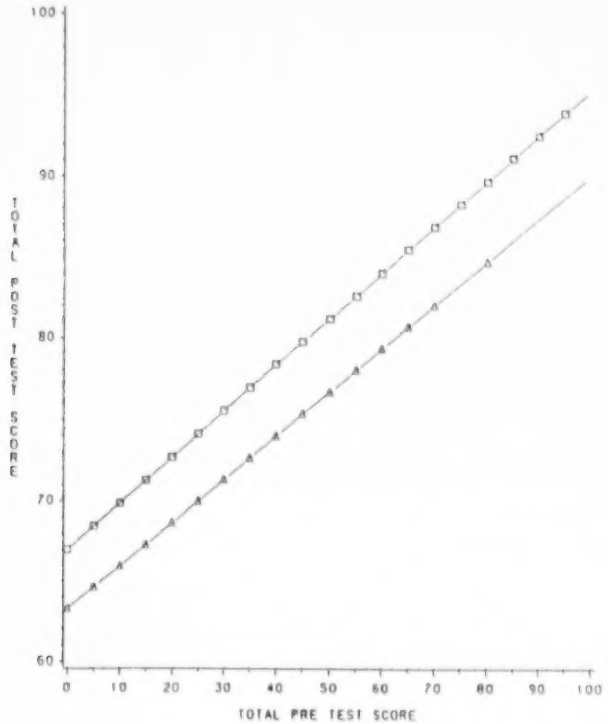

Figure 1. Linear regression lines of two types for teaching mode 1 population

Academic schools are represented by squares.
Non-academic schools are represented by triangles.

The results indicate that students who studied intensively, regardless of their type of school, improved their scores, and the gap which had existed between academic and non-academic students in the pre-test was closed as a result of a full and correct implementation of the curriculum. Another interesting conclusion which may be drawn from figure is that the effect of teaching mode 1 on the non-academic students was stronger than the effect on the academic students. Non-academic achievers benefited the most from the course.

To gain deeper insight into the source of this effect, a comparison between the two teaching modes was performed. A comparison between the pre-test performance of the non-academic students in teaching mode 1 schools and those of teaching mode 2 schools confirmed our assumption, that the two groups may well be considered one population.

The regression lines of the two teaching modes are drawn on the graph of figure 2.

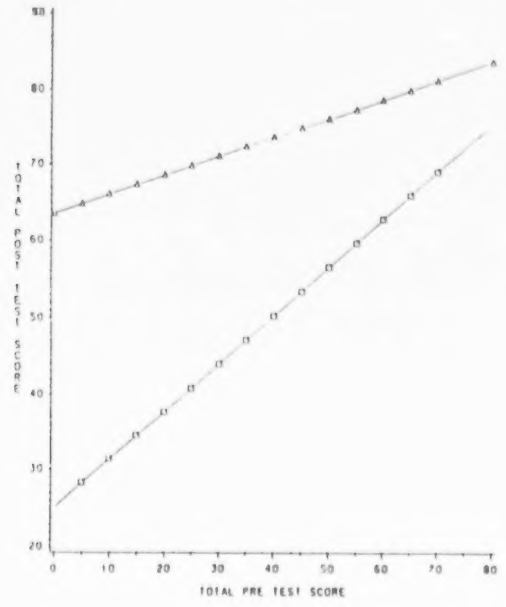

Figure 2. Linear regression lines of the two teaching modes for non-academic students

Schools which fully cooperated (teaching mode 1) are represented by triangles. Schools which used the curriculum as auxiliary material (teaching mode 2) are represented by squares.

The results demonstrate the great difference in post-test outcomes between the two teaching modes. The pre-test gap, which had existed between high and low ability students of teaching mode 1, was reduced, while for teaching mode 2, that gap was retained.

The difference between the two teaching modes is smaller for high ability students. This may be attributed to the fact that these students are capable of benefiting from reading the textbook regardless of teaching mode.

In the affective domain, students who used the textbook wrote that the material was clear, and that it helped them to understand various subjects. These students also wrote that the case studies and examples in the textbook contributed to their understanding of the relationship between nursing and chemistry. In the post-course evaluation, using an open attitude questionnaire, it was found that students are very enthusiastic about the new textbook. Both teachers and student nurses indicated that the new curriculum fulfilled a need for a chemistry course for nursing schools, contributed significantly to the improvement of the image of chemistry, and, last but not least, diminished the anxiety often caused by the study of chemistry.

Conclusions

On the basis of the findings of the research it is suggested that schools continue to incorporate the "Chemistry for Nursing Schools" curriculum in Israel. To ensure the best results, teachers are recommended to teach all the chapters of the textbook; to

use the teaching aids and the exercises found at the end of each chapter; and finally, to examine the students after the course, using multiple choice questions from the set of questions.

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